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ABSTRACT

This paper describes a critical study of the available forecasts and forecasting studies for the home video player market over a 15-year period which was undertaken to discover why so many forecasts were wrong about consumer adoption of home videocassette players and videodisk players, the reasons for these errors, and ways in which this knowledge can be applied to planning and forecasting the development of new communication technologies and services. An overview of forecasting methodologies and a brief history of the development of home video players are provided as background information for a discussion of the 29 forecasts collected from market research firms, government, academic, and other sources. These forecasts are then summarized and compared with actual events. Common forecast errors identified through this exercise are discussed, and suggestions for improving future market forecasts are offered. Both a listing of the forecast studies in chronological order and a 35-item reference list are included. (DJR)

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Forecasting the Market For New Communication Technology: The Home Video Player Experience

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ABSTRACT

Forecasting consumer adoption and diffusion of new communication technologies remains an inexact science. Few studies of past efforts to forecast new technologies have been attempted. The available forecasts and forecasting studies of the market for one genre of a communication technology--home video players were collected and studied. Forecasters only five years ago predicted that the videodisc player (VDP) was destined to become a mass consumer item while the videocassette recorder (VCR) would remain a limited appeal, luxury item. The actual home video industry developments are compared and contrasted with events forecast by twenty-nine market research and other forecasting studies. Common forecast errors are cited and suggestions for future forecasts are offered.

INTRODUCTION

Home video is perhaps the most explosive area of the new television technologies today. While approximately 30% of all television households now own videocassette recorders (VCRs), the current success of the VCR was not anticipated only five years ago. Indeed, many "experts" predicted that the videodisc player (VDP) would be the home video player of choice in more American households in 1986. Why were so many forecasts wrong about consumer adoption of home video technology? What can be learned from their errors? How can this knowledge be applied to planning and forecasting the development of new communication technologies and services?

While forecasts continue to be produced from a number of sources, very few studies have been made of the lessons learned from past forecasts. A critical study of the available forecasts over a 15-year period for the home video player market was undertaken to investigate this question.(1) Twenty-nine past home video technology and market forecasts were collected from market research firms, government, academic,

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and other sources. These forecasts are summarized and compared with actual events.

A review of the literature reveals very few formal evaluations of past forecasts. This may be explained by the fact that forecasting as a discipline is quite young. The Journal of Forecasting, for example, was founded in 1982. Technological forecasting and technology assessment are also young disciplines. Thus, relatively few formal forecasts existed before the 1960s. Few forecasters have published the successes and failures of their past forecasts. As the body of dated forecasts grow, more study of these forecasts may be undertaken.

Overview of Forecasting Methodologies

A number of forecasting methods could have been applied to forecasting the adoption of home video players from technological forecasting to new product forecasting methods. Technological forecasting, according to Martino (1983), is "a prediction of the future characteristics of useful machines, procedures or techniques." A technological forecast is made before the technology diffuses. Its methods include Delphi, historical analogy, growth curves, and others. The Delphi procedure uses a committee of experts who anonymously submit a series of forecasts. Forecasts after the first round benefit from anonymous feedback from the other experts (Martino, 1983, pp. 14-46). Historical analogy "involves a systematic comparison of the technology to be forecast with some earlier technology that is believed to have been similar in all or most important respects (Martino, p. 39)." Growth curves assume a pattern of technological development and/or market penetration. Technology assessment, the systematic study of a given technology and its potential impacts, is also a relatively new field (c. 1970) and could form the basis for technological forecasting (Coates and Finn, 1979).

New product forecasts are made based upon consumer buyer intent surveys, the product lifecycle (development, introduction, growth, maturity, decline), the

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diffusion of innovations, and time series analysis where sales data are available. Beville (1966) applied the product lifecycle (and diffusion theory) retrospectively to discover the factors which were responsible for the adoption of color television sets. Bolton (1983) applied diffusion theory to predict the likely consumer rejection of a prototype videotex system. The Bass (1969) model applies the logistic growth curve to describe purchase and imitation behavior. Dodds (1973) used the Bass model to predict that a video technology--cable television--was already approaching market saturation then. More recently, Lancaster and Wright (1983) applied the Bass model to British VCR growth and predicted that sales would peak in 1984; actual data (Euromonitor, 1984) indicated a 50% decrease in 1984 after a flat 1983.

Studies of the accuracy of new product forecasting exist. Tull (1967), for example, investigated the accuracy of new product forecasts by various companies and found an average forecast error of 65% for new product unit sales and 128% for new product profits. Other similar analyses of new product forecasts, especially those employing time series analysis, are also available.

Very few studies of technological forecasting accuracy are found in the literature. Wise (1976) analyzed more than 1500 technological predictions made from 1890-1940 by a wide variety of "forecasters." He found very little difference in the accuracy of experts and nonexperts in forecasting a given field. Pool (1983) looked at past technological predictions made for the telephone during a similar period: 1876-1940. He concluded that economic and marketing considerations were the most important predictors of actual telephone development and that "[t]he best forecasts made about the telephone arose from...analyses by people who both understood the technology and sought to assess how to implement it in a way that would pay (p. 156)."

Because we only recently have entered or are entering the forecasted period of many more formal technological forecasts, few research pieces are available which

examine their projections. Arthur D. Little's Frederic Withington (1985) is a recent exception. Withington looked back at his forecasts for the evolution of computer technology to conclude that forecasts which are market-driven (i.e., matching unmet user demands with technological potentials) are the most reliable.

Ascher (1978) conducted the most comprehensive analysis of past technological forecasts currently available. He investigated the accuracy of over 165 forecasts from six subject areas. He found, for example, that nine of twelve forecasts for computer technological capabilities erred optimistically. Ascher argues for accuracy as a benchmark with which all forecasts in a given topic area may be compared. Among Ascher's key findings regarding the inaccuracy of forecasts is that of "assumption drag"--the continued use of assumptions long after their validity has been contradicted by empirical data.

Twiss (1980) has pointed out that accuracy should not in and of itself be the only criterion of forecast utility. Moyer (1984) picks up on Ascher's work to address possible reasons why forecasts often fail to predict future events accurately. Moyer offers reasons for the failure of long-term forecasting which include oversight of underlying (social) forces, failure to consider technological substitution, common assumptions held by forecasters, and intentional forecaster bias. Godet (1983) argues that three key factors are responsible for many forecasting mistakes: 1) inaccurate data coupled with unstable models; 2) lack of a global, qualitative approach; and 3) explanation of the future in terms of the past. Godet advocates the use of forecast scenarios due to the unpredictability of human actions and interactions. Twiss (1984) similarly argues that "(a)lthough the techniques of forecasting may sometimes appear as scientific relationships, they are in reality only a model of how human beings are behaving" (p. 21). Like Godet, Twiss suggests that managers should be concerned with a number of possible outcomes rather than one forecast possibility.

METHODOLOGY

Few models on which this study could be based were discovered. Amara and Salancik (1972) suggest a way to examine "forecast quality" and Martino (1983) has suggested an "interrogation model" for looking at forecasts. Unfortunately, the acquired forecasts lacked the specificity needed to apply many of the criteria put forth by these authors. This study is a preliminary effort to report and critically analyze the available forecasts.

To address the research questions posed above, past home video player forecasting studies were collected for critical analysis from both the public and private sectors. Forecasting studies are research reports produced by home video industry players and observers based upon some formal input of thought or data. Excluded from this definition are public predictions made by corporate officials and others which are also often reported in the trade and business press.(2) While a number of new technologies could have been chosen for this study (such as cable television, CB radio, personal computers, satellite antennae, etc.), home video proves to be an especially appropriate area of study. Reasons include:

1. an established technological history dating back to the 1950s and beyond;

2. the study of several related but distinctly different technologies;

3. forecasts for one home video technology often included others;

4. the entire life and death of one home video technology could be chronicled (RCA discontinued its videodisc player in April 1984);

5. another home video technology, the VCR, has entered the rapid growth stage of diffusion (i.e., it is clearly a successful new technology); and

6. the success of a third home video technology, the optical videodisc, remains to be determined.

Because a detailed history of the development of the home video industry was not available, one was compiled. A concerted effort was made to identify and collect every available forecasting study of home video. Obviously, many proprietary studies

were not available for this research. Rogers (1976) has already noted this same difficulty in previous efforts to advance new product diffusion research. As a result of this as well as the lack of previous research, an exploratory study of the successes and failures of forecasting as applied to one new technology is needed. Actual events were compiled as reported in the trade and business press (e.g., Broadcasting, Variety, The Wall Street Journal, etc.). Forecast studies were collected from government, market research firms (including Arthur D. Little), industry players (RCA), investment analysts (Drexel Burnham Lambert) and academics.

A BRIEF HISTORY OF HOME VIDEO PLAYERS

While the history of home video technology dates back to the 1920s with John Logie Baird's mechanical videodisc player (Sigel, 1980), successful videotape recording technology was introduced in the 1950s (see Rosenbloom and Freeze, 1985 and Shiraishi, 1985). The impetus to develop videotape was to produce a machine that would allow broadcasters more flexibility in program scheduling. Ampex impressed the broadcast industry in 1956 with a successful demonstration of its Mark IV videotape recorder, later called the VR-1000. Ampex took the technology to Japan where it was shared for a time in a joint venture with Sony. Sony demonstrated its open-reel CV-2000 ("consumer video") to the U.S. in 1965. Videotape technology gradually progressed as equipment became continually smaller and less expensive making a potential home market for the technology seem possible. Among the manufacturers who unsuccessfully went after the home market with a VTR (videotape recorder) in the 1960s were Matsushita (Panasonic), Philips (Norelco), General Electric, 3M, and Bell & Howell. High price (over $1000 in 1970 dollars) was the major obstacle to the home user ("Video Playback," 1970). Some technical difficulties remained to be solved as well (Rosenbloom and Freeze, 1985).

CBS developed a film playback device for use with the home television set in

the late 1960s. Called EVR (Electronic Video Recording), it played 8.75mm film cartridges with sound on the television set. Individual frames also could be frozen allowing the display of text. Unfortunately, little new software was produced for the home market; in fact, some early software was taken from the public domain (government films). CBS also feared the impact a successful home EVR might have on its network television business and ceased its EVR operations in late 1971 (Goldmark, 1973). Archrival RCA reacted to CBS's EVR by demonstrating a primitive holographic tape television player in 1969; RCA was unable to come very close to a production model (Graham, 1980).

Sony, meanwhile, had discovered another barrier to the diffusion of its VTR--the complexity of its operation. Users had to be trained to thread the open-reel device. In other words, the CV-2000 was not "user-friendly." Out of the recognized need to develop a VTR which was simple to use came the first "videocassette" recorder (VCR). The book-size cassette can be easily inserted into the VCR. Sony first demonstrated its "U-Matic" 3/4" VCR in 1969. At a 1972 market introduction price of $1600, it was too expensive for home users. It was, however, quickly adopted for institutional, business (training), and broadcast users (Lyons, 1976).

"Video cartridge" (the generic name used at the time for videotape, film cartridges, and videodisc prototypes) competition was keen in the early 1970s with seven major corporate players vying for position (Newman, 1971). The combination of the various home video technologies both being introduced and in differing stages of development served as a catalyst to spark the interest of many observers. This, in turn, resulted in the production of early home video forecasts.

Germany's AEG-Telefunken and British Decca in a joint venture were now developing the Teldec mechanical VDP. With a speed of 18,800 rpm, the discs were limited to a maximum of ten minutes playing time. The player was demonstrated but never

marketed in the United States. In the laboratories of RCA, meanwhile, work was progressing on its capacitance electronic disc (CED). CED technology works much the same as the common phonograph; a diamond and metal stylus senses the electronic information on the disc tracks as the disc rotates at 450 rpm (four TV frames/revolution). MCA (Music Corporation of America) and consumer electronics manufacturer NV Philips separately developed similar optical videodisc systems in which a laser "reads" microscopic pits etched on the disc's reflective surface. At a rotation speed of 1800 rpm (one frame per rotation), features such as freeze frame and slow motion are possible. MCA and Philips combined their laser videodisc (LVDP) efforts in 1972. A fourth videodisc system, Matsushita's VHD ("Video Home Disc") was licensed to GE but has yet to be introduced in the United States. It is finding considerable success in Japan today, however (Cohen, 1985).

In the early 1970s, RCA and Philips each tried to outdo the other in publicly announced product introduction dates, player and software prices, and breadth of software availability. Sony, meanwhile, further refined its 3/4" U-Matic design. The result was the smaller Betamax which used 1/2" tape and was introduced in the U.S. in 1975. While Sony's VCR sold in 1976 for $1300, licensees (e.g., Toshiba and Sanyo) were selling Beta models for under $1000 less than a year later. Sony decided not to push the development of a prerecorded software market, noting the lack of earlier success in that field. Sony's modest expectations for its VCR were generally met and exceeded.

Rival Matsushita developed its own 1/2" VCR in the early to mid-1970s through its 51%-owned Japan Victor (JVC) subsidiary. Sony and Matsushita discussed a common standard, but neither was willing to accept the other's technology. The JVC "Video Home System" or "VHS" design improved over the Betamax design by allowing a slower recording speed and slightly larger cassettes with more (thinner) tape; this resulted in longer recording times (4 hours to Beta's 2 hours) but lower video quality. RCA

became a VHS licensee and introduced the VHS VCR in August 1977 priced $300 less than the Betamax. Within two years, the lower-priced, longer recording VHS already controlled 57% of the U.S. VCR market (Nulty, 1979). Total VCR annual unit sales rose from 402,000 in 1978 to 3,354,000 in 1983 and 11.8 million last year (Electronic Industries Association, 1986).

The following list summarizes observations about the key factors surrounding the historical development of the VCR market:

1. While the lack of a standard VCR format may have hurt early consumer adoptions, two competing formats were not a barrier later.

2. Inter- and intra-format competition (as well as the perceived threat from the VDP) led to technological innovations (more features--longer recording, programmability, stereo sound, lower prices, etc.), increased consumer awareness via advertising and promotions, and lower prices.

3. The primary use of the VCR by innovators and early adopters was for "time shifting" broadcast programming, not for viewing prerecorded fare (3).

4. Prerecorded software availability was not a key factor in earlier VCR purchase decisions (although that may not be said today).

At about the same time as it was introducing its VHS VCR, RCA had to retrench its CED videodisc plans in 1977 when an in-home test revealed that its discs were too sensitive to house dust and normal handling. A better method of pressing the discs was also discovered (Butterfield Communications Group, 1983). While both RCA and MCA/Philips had several false starts in the mid-1970s, Philips (through its U.S. subsidiary Magnavox) finally managed a market test in late 1978. Two hundred disc titles were available, but very few were original material and half were movies. The "Magnavision" was priced at $695 which some observers believed was below cost (Burstyn, 1979). Technical problems cropped up with both the hardware (tracking motor) and the discs (as many as 90% were faulty). The player price was soon raised to $775 ("RCA to Offer," 1979). Ironically, this happened as VCR prices were dropping.

With the optical videodisc having problems and the VCR still seemingly over-

priced for the mass market, RCA introduced its $500 CED "Selectavision" VDP in March 1981. Only 100 titles, half of which were movies, were available and ranged in price from $20-$28; consumers had to order most of what little was available from RCA rather than being able to pick them out at the dealer's shop. RCA backed the market introduction with a multimillion-dollar promotional campaign and set high expectations for first year sales. When early figures paled in comparison to RCA's predicted numbers, dealers quickly lost interest. Some consumers who went to buy a VDP were instead sold a videocassette recorder ("It's Skipped Discs," 1981).

Sales never developed as RCA had hoped they would despite the addition of technical features (such as stereo sound and slow motion). RCA announced in April 1984 that it was discontinuing production of its VDP at a total loss of $580 million. About 550,000 players had been sold up to that point (Salmans, 1984). The optical videodisc had been adopted by far fewer consumers. MCA-Philips announced in late 1984 that they would begin concentrating on the institutional rather than the home market.

A number of reasons were subsequently cited for the videodisc's (especially the Selectavision) poor showing vis-a-vis the VCR:

1. The Japanese "dumped" VCRs at below cost prices as low as $500-$600 to maintain their dominance of the home video industry.

2. The videodisc player offered consumers only the lesser attractive playback option already available with the VCR, and ironically more software was available on videocassettes than was available on either videodisc format (4). (Consumer's Research Magazine, 1982, refused to review the VDP since it viewed the VCR as a far better home video choice.)

3. Very little videodisc software was available to consumers, further reducing the value of the videodisc player.

4. No one foresaw the development of a videodisc rental market which undercut the only profitable portion of the business--disc sales.

5. RCA blamed the economic recession of the early 1980s for hurting the videodisc player (although the VCR continued to do well despite its higher price).

6. RCA introduced the player in March, not a traditionally good time for introducing a "brown" consumer durable good (e.g., radio or television set).

7. Optimistic videodisc player sales forecasts made the actual sales appear to be very poor. One RCA official went so far as to blame poor sales on "excessive optimism in forecasting." The fact that the Selectavision outperformed color television in early sales was lost.

8. The optical VDP lost any price advantage it had over the VCR.

9. Marketers of the optical VDP did not take advantage of the technology's medium-specific technological advantages (such as random access).

In sum, the utility of the VCR lay in its allowing the user to "program" his/her television set. Consumers viewed the videodisc player as a VCR that could not record. The videodisc player also put the viewer in a new role; the VDP required an active, selective viewer while the VCR simply extended existing television viewing behavior. No demonstrated need for a home video playback-only device had been shown. Nevertheless, videodisc marketers dwelled on the lower cost of the VDP versus the VCR and discs versus prerecorded tapes. The additional cost of the discs, however, made the VDP more expensive to use than the VCR. As the VCR player universe grew, more software was made available at both lower rental and purchase prices. This made the VDP an even less attractive option. Home video adopters were willing to pay extra for the much more versatile home video machine.

HOME VIDEO PLAYER FORECAST STUDIES

The actual development of the home video market can now be compared with the forecasts which were made for that market. Twenty-nine reports on the future of home video were collected and critically analyzed (they are referenced in the Appendix). Generally, an effort was made to identify and collect all the reports that were available. Unfortunately, some of the more sophisticated analyses may not have been available as corporate players in the home video field were not anxious to share even dated proprietary studies. While the authors and/or sources and the audiences for the reports are diverse, the common thread is their treatment of the future home vid-

TABLE: Summary of Forecasting Studies

STUDY/YEAR	AUDIENCE	METHOD	FORECAST ABSTRACT	RIGHT	WRONG	OTHER COMMENTS
Dialing et al. (1968)	government (policy makers)	unspecif'd economic model	EVR could reach 50% penetration; 20% more likely by 1970	software must bear repeat viewing, rental could lower cost	predicted households would purchase only 2 video records/year	assumed manufacturer announced low player and software prices
Martin Roberts (1970)	general reader (layperson)	descript'n and speculat'n	vid. cass. to displace existing media with various uses	software more in doubt than hardware; CATV is competitive	production will peak by 1975; 2 videotape formats cannot work	new medium will supplant old; only sees endstate scenario
Holm (1971)	Society of Mot. Pict. & TV Engin.	industry expert opinion	videocassettes will succeed only if they meet social needs	specialized software better suited to VC than mass appeal	super-8 film lesson: one standard needed for mass acceptance	extraordinarily insightful; skeptical of technology-push
Kletter and Hudson (1972)	cass. buyer home, libr, and schools	descript'n	examines social impact rather than economics/marketing	buyers should wait for shakeout; CATV does what VC will do	CATV penetration may be 50 million households by 1980	concentrate on prerecorded software, not recording option
Elion and Thompson (1972)	Arthur D. Little clients	historical analogy to color TV	30% cass. penetrat'n by '80;supply-side & technical orientat'n	institutional market develops first; see more techn. innovat.	tape & disc to share market in mid-1970s; 1980 penetration 30%	supply-side orientation; little discussion of user needs
Christians (1973)	J of Brdcst academic readers	historical analogy to radio ind.	home video will not be a revolution; no innovative software	conservative corporate involvement will stifle sftwre innov.	(does not discuss consumer demand for innovative software)	notes failure of forecasts to take a wholistic approach
Dann (1973)	video/film industry convention	industry expert opinion	original software is needed to make the medium grow	>1 format will survive; use of existing software is weak	(generally accurate assessment)	technical advances were surpassing programming efforts
Mathematica Inc. (1973)	educational policy makers	economic anlyses of media csts	economic description of various new media including vid. cass.	decreasing VCR costs meant VCR would replace 16mm in school	assumed manufacturer announced timetables	videodisc seen as most economical for program storage
RCA (1974)	RCA internal management	sum. of cons.srvys hist.anlgy	summary of market research thru 1974; 3 forecast scenarios	longer period (4-5 yrs) would be needed for initial 2% pen.	VDP to diffuse faster than color TV;all scenarios optimistic	result of wishful thinking; evidence bent to support VDP
Daynes (1976)	U.S. Navy training personnel	Delphi forecast	videodisc tech. and applications for '86 esp. for training	market to determine standards; training uses of VDP by 1986	software to spur VDP hardware sales with 5% penetrat'n in '86	agreed on technical, but social issues; supply-side oriented
Kagan (1977)	business/ investors	historical analogy to color TV	VDP and/or VCR will diffuse as color TV did: 34 mil./10 yrs.	player prices will drop due to competition	does not distinguish between VCR/VDP: 48% total pen. by 1986	fails to analyze software needed for VDP and VCR growth
Creative Strategies (1977)	peripheral home video industries	unspecif'd (market analysis)	moderate VCR success to spur other business opportunities	VDP will not compete with VCR; price is VCR's only barrier	VCR sales to decline '78-'79; underestimated VCR price drop	user-oriented; VCR has viewer utility; cable competes w/VDP
Beville (1977)	TV Quartrly readers (acad/ind.)	industry expert opinion	VCR will succeed as it's better suited to selective viewers	VDP is not a viable consumer product; VCR prices to drop	VCR 50-60% penetration limit due to complex VCR operat'n	viewer-oriented; correct forecast of VCR success/utility
Curtiss et al. (1978)	Arthur D. Little clients	consumer telephone survey	survey shows consumers most interested in VCR for recording	price barrier; VDP could compete IF announced plans happen	VCR price drop unlikely; 8-10% penetration by mid-1980s	missed VCR price drop;foresaw Japan's VCR overcapacity
Quantum Science (1978)	Quantum Science clients	consumer panel survey	$1.1 billion VDP, $1.2 billion VCR shipments in 1985	VCR too expensive; VCR/cable symbiosis; VDP needs many discs	viewers want more TV shows; prerecorded VC vita to success	consumer panel revealed disc needs; user-oriented study

TABLE: Summary of Forecasting Studies (continued)

STUDY/YEAR	AUDIENCE	METHOD	FORECAST ABSTRACT	RIGHT	WRONG	OTHER COMMENTS
Management Horizons (1979)	retail store clients	market analysis	VCR&VDP to equal <2% pen. by '80,4-9% '83 25-50%+ by early 90s	25% home video penetration by 1985; music video possible	TV viewer dssatsfctn to spur home video; home video studios	accurate projections mixed with blue sky expectations/impacts
RCA (1979)	RCA internal management	consumer coincidntl interviews	VCR, VDP showed to mall shoppers; 15% intrsted in $500 VDP	few interested in VD at any price; prefer VCR at all prices	interpreted as VDP being price inelastc (biased interpret'n)	different interpretation of survey: little VDP interest
Reidy (1979)	investors	industry analysis	forecasts all media; VCR a luxury item; RCA VDP a mass item	VCR used to time shift; VCR '79 price too high for most	10 mil. VDP by '85; VCR price to stay hi flat growth past '80	same VCR conclusion as Creat.Strat.; no VD software analysis
Anderson (1980)	investors	historical analogy to color TV	VDP to grow as color TV '80-'85; VCR 1985 penetrat'n to be 14%	VDP informat'n storage potential for education is noted	VCR no threat to VDP BOTH will grow like color TV did	simplistic forecast; VD's high technology will ensure success
Agostino et al. (1980)	FCC Network Inquiry Staff	market analysis	VCR 10-14% penetration peak; VDP to pass VCR in sales in 5 years at 1 mil./yr	VCR studies show use is time shifting; recognize inherent forecst difficulties	2 formats hurt VCR; VDP, VCR prices will RISE;see VDP success despite own quest'ns	quote consensus; saw software barriers; noted weak VCR growth vs.current forecasts
Richards (1980)	Independent Television Association	consumer mail survey	VCR owners dn't want VDP; VDP owners want VCR, music viddiscs	VDP owners: buy 16 discs/year; VCR: 50% NEVER bought softwre	VCR and VDP will coexist in (upper income) households	user-oriented study foresaw VDP failure; VCR utility=success
Boggs (1980)	Venture Development clients	cons.phone survey & ind.anlys.	nonowners prefer VCR to VDP 3:1; both prices coming down	VCR lower price, new tech. mean VC to out sell VDP for 5 years	only 1.6 mil. VCR sales in '85; VDP still will succeed	correct in VDP pessimism, not optimistic enough for VCR
Drysdale (1981)	RCA Engineer readers	internal expert opinion	ALL video viewing to increase;VCR 17% '90 pen.; VDP 28% in '90	(broadcast television will remain healthy)	VCR price to be much higher than VDP; VCR & VDP won't compete	technology push;many viewers would buy all new video prod.
Pool (1981)	Foster Advertising clients	industry analysis	VCR 12% pen. by '85; VDP 6% by '85; other studies are quoted	VD sales to lag behind VC in 80s; VCR used to time shift	1/4" VCR standard in '85; slow VCR growth '82-'85; VDP success	benefits from early VDP market results; similar to Boggs
Nat'l Assoc of Brdcstrs (1981)	broadcast industry	expert opinion	will VDP slow VCR? rentals helping VCR; new software needed?	VC rentals big; VCR growth despite intro of RCA VDP was noted	(cites recent developments and implications)	concentrates on actual developments, not forecasting
Cameron and Edmunds (1982)	Canadian policy makers	market & industry system analysis	33% home vid. pen. by '90; optical disc has mass storage use VCR versatility best	disc potential is in education; VCR far more user-oriented; no need for home VDP	(forecasts are made with qualifications so most statements are correct)	most thorough analysis found; benefits from early market develpment; unbiased
Reidy (1982)	investors	industry analysis	"correction" of '79 report; CATV, rental cass. look strong	CATV/VCR synergistic; questions historical analogy forecasts	VDP: 1.8 mil. by '84 4.5 mil. by 1986, 9 million by 1988	cable and broadcast TV are secure, but still bullish on VDP
Butterfield Communictns Group ('83)	public broadcast industry	expert industry analysis	VCR to hurt VDP esp. 1/4" in '86; 4.5 mil VDP by '86, 9m by 88	new video helps VCR, hurts VDP; rental VC competes w/disc sale	9 mil. VDP by 1986 despite pro-VCR home video assessment	similar to other VDP optimistic forecasts despite neg.evidence
Communicatn Studies & Plan. ('84)	clients	market analysis	VCR US pen. 40% '90& large foreign market erasable disc by '90	declining tape and duplicating costs to lower videocas price	(LVDP too expensive for home use)	descriptive report; short-term forecast; VCR is a success

eo market.

The reports date back to 1968 and are summarized in choronological order in the Table. "Audience" is the intended user of the report. The "Method," though rarely specified, is listed and in many cases is the presumed manner by which conclusions were reached. "Forecast Abstract" includes the report's major prediction (market projections are listed if made). Each report made both right and wrong assessments, and they are noted along with some comment. Generally, the reports included remarkably similar assumptions about and forecasts for the home video industry. The Table summarizes the studies analyzed for this paper. General observations are reported below.

Not surprisingly, the audience to which the report is directed had some bearing on its content. Few studies were pessimistic especially about the videodisc player. Many of the reports were written for investors and painted a very rosy picture of the home video market. An optimistic bias in such reports seems almost inherent; Wall Street analysts and other outside marketing research organizations key in on what look like rapid growth industries. Home video held the potential of penetrating every television household in America. In addition, the source of the information upon which early forecasts are based may be traced back to the home video manufacturers; few outside experts exist when a new technology such as the VCR or VDP is developed. Manufacturer estimates of the potential market and range of player applications will, of course, be optimistic both to justify the manufacturer's involvement in the industry and persuade others to invest in it.

Although a number of forecasting methodologies were employed, many of the reports did not specify a method by which forecast conclusions were reached. Historical analogy is used when a new technology is projected to follow the growth patterns of older technologies, and this method was often employed in the text of the forecast reports. Unfortunately, the comparisons are not useful in helping to

understand why people make a decision to adopt the technology. Instead, similar market diffusion rates are predicted between home video technology and (usually) television technology. Some analogies were inappropriate. Roberts (1970) argued that videotape players might outsell VDPs just as audio cassette recorders were outselling phonographs at the time, 2-1. Since more people already owned a phonograph than an audiocassette recorder, more people were in the market for the tape recorder. VCR forecast analogies to color television similarly ignore the fact that consumers were buying color sets to replace old black-and-white sets (Beville, 1966). The VCR represents an entirely new product adoption.

Consumer surveys were also used as a basis for forecasting. Depending on how they were interpreted, some turned out to be a poor input for forecasting while others uncovered revealing insights which at times were ignored. Consumer panels (in which groups are interviewed in depth for their attitudes and beliefs about products (Quantum Science, 1978) did reveal a greater interest in the VCR among both videoplayer owners and nonowners. RCA (1979) found 15% of mall interview respondents interested in a VDP at $500 and only 18% interested at $250. RCA concluded that the VDP was not price sensitive; another conclusion could have been that there was very little interestin the VDP at any price (or some respondents will say they are interested in virtually any new product). Boggs' (1980) consumer survey also uncovered a lack of interest in the VDP.

One of the most sophisticated studies methodologically is Daynes (1976) which employed the Delphi method noted above. In the home video technology forecast, the experts agreed on probable technological developments (which also turned out to be quite accurate) but disagreed on social impact issues (such as the impact of home video on theatrical film and what software would be most appealing to home users). This suggests that technological factors may be more predictable than social factors in forecasting the adoption and diffusion of new technological products.

Economic models were employed by Dimling et al. (1968) and Mathematica (1973) which led to more prescriptive (what is economically feasible) than predictive conclusions. Analysis of the potential for home video by outside industry experts (Holm, 1971; Christians, 1973; Dann, 1973; and Beville, 1977) often included the most insightful assessments about the future of home video; they recognized the dependence of the VDP in particular on the supply of software. Cameron and Edmunds (1982) brought a detached Canadian perspective which seemed to allow them to question others' assumptions; this may have been the most objective study discovered.

The forecast studies tended to overemphasize technical descriptions of the home video hardware. While this information is important to understanding the technology's potential applications, few forecasts adequately tied those capabilities to consumer needs. Instead, some reports gave unrealistic scenarios about potential applications. Management Horizons (1979), for example, said homes would be equipped with "dubbing systems that allow people to add sound programs on tape, film, or slides; videotape editing devices; and an abundance of storage racks and cabinets for the software and hardware that will comprise the various systems (p. 328)."

The following list summarizes some common mistakes made by the forecasters in their treatment of home video player hardware:

1. The importance of VCR recording length was overlooked. Longer recording times allowed consumers to record more than one program and longer programs such as sporting events and television specials.

2. Most forecasters expected the videodisc player to be the mass consumer item with the VCR remaining an expensive luxury item. Very few forecasts specified a method for these forecast expectations. The forecasters missed predicting the reaction of VCR marketers to the VDP introduction as well as the impact of the VCR's inter- and intraformat competition.

3. Many forecasters erroneously believed the lack of VCR standardization would hurt the VCR by causing consumer confusion. Instead, the competition led to increased VCR options, great promotional efforts, and lower prices.

4. Early forecast expectations for home video were overly optimistic often due to the reliance on optimistic manufacturer-announced product introduction dates.

5. Many forecasters concentrated on videodisc technical issues as if the technical

sophistication of the players would ensure success. Neglected was the utility of the players to the users.

Early videotape recorder forecasters assumed prerecorded software was a prerequisite to consumer adoption. As noted, user studies do not confirm this. The forecasters may have been reacting to the plans of the manufacturers to supply software rather than examining the need for software. Videodisc forecasts generally did not examine what software was needed to make the purchase of a player compelling enough. While the television viewer had grown accustomed to selecting generally from the three networks, the videodisc technology forced the viewer into a much more active, selective role. Two key qustions which needed to be addressed are what programs would the VDP user wish to own and what programs bear repeat viewing? These questions, however, were not addressed in the forecast reports.

Also overlooked was the question of what original software would be produced by the manufacturers. While forecasters accepted that some original software would be developed, manufacturers began by supplying what was already available. No impetus existed to produce original programming until enough units were sold to ensure a good chance of home video economic viability. The very simplistic assumption was that the manufacturers would supply "enough" software to make the videodisc player attractive.

Most forecasters neglected the impact of the software rental market which was critical. VCR owners purchased their recorders for time shifting existing TV programming; inexpensive videocassette rentals were "icing on the cake." The development of this market was disasterous for the VDP. The creation of a videodisc rental market, which was a boon to both VDP owners and home video outlets, was unforeseen; but it changed the economics of the production of videodiscs which was based upon videodisc sales.

Considerable agreement existed among the forecasts that the VCR was destined to remain a luxury item due to its high cost relative to the VDP. Conversely, most forecasters expected the VDP to achieve mass market success. This is explained two

ways. First, the forecasts were based upon similar assumptions (some of which were in error). Second, new forecasts cited earlier forecasts creating a "bandwagon effect." Rare was the home video forecast which questioned the commonly held assumptions about the future of the home video industry. Probably the simple, most general criticism which can be made about the forecasts is that too much attention was paid to technical factors and far too little to user needs. Ample (although sometimes erroneous) supply-side or producer considerations overshadowed critical demand-side (user) concerns.

CONCLUSIONS

When an innovation such as a home video player appears on the forecasting scene, optimism abounds. The only sources of forecast information during this phase of technology-push are generally the developers of the technology and those most likely to benefit from its wide diffusion. An optimistic bias is inherent to the process--the innovation would not be marketed without some expectation of consumer acceptance. This early optimism has another biasing effect. Because early expectations for the innovation may be overly optimistic, early market performance may pale in comparison as was the case with the videodisc player in particular.

Forecasters easily envision end-state scenarios in which the technology is used in a myriad of applications. This is symptomatic of technological determinism in the forecasts; that is, the technology's capabilities suggest utility for a multitude of potential users. Intermediate stages between the necessary technological development/market introduction stages and the envisioned end-state application is often overlooked. As the history of home video shows, many technical difficulties are not discovered until the product is put to a market test.

Early home video forecasts were enamored with technology often beginning with a detailed explanation of the design of the technology. Consideration of demonstrable

user needs are often missing from development strategies as well as early forecasts. Videodisc technology remains an impressive technological achievement; but until (and unless) manufacturers supply unique software at a reasonable price, no compelling reason exists to purchase one. Home video technology was developed by equipment manufacturers who needed a new product as color television set sales matured and in the case of MCA a company that wanted a new medium for software distribution. In other words, the technology was developed to meet supplier needs, not user needs.

Missing from most of the home video forecasts was careful consideration of both complementary and substitute media. The VDP's functions are duplicated by the VCR and to a lesser extent by cable television (e.g., HBO). No substitute exists for the VCR's time shifting capabilities. VCR owners originally used the device to time shift programming. As the player universe grew and inexpensive software became available (both through rentals and lower priced prerecorded cassettes), users began to include the playback-only function of the VCR.

Considerable interaction between home video forecasts was also discovered. Most home video forecasts built upon and/or cited existing forecasts, and most forecasters agreed with what others had said. Thus, errors and/or weak assumptions in one forecast (e.g., VCR prices will remain high) were often repeated in another.

Although Ascher (1978) argues for accuracy as a criterion for comparing technological forecasts, this study supports Twiss (1980) by showing that accuracy can be an inappropriate way to evaluate forecast quality. Some forecasts were quite accurate for the wrong reasons or purely by coincidence. The quality of the evidence used to support claims is a better measure of forecast validity. This study also revealed that few of the available forecasting studies offered evidence to back the assumptions or predictions made. Forecast consumers should demand this information and forecast producers should supply it.

The following list summarizes the limitations of the forecasts:

1. Most of the forecasts were not critical. Consumer adoption was assumed followed by a search for reasons to back up the expected success. Careful scrutiny of consumer application of the home video player was unusual.

2. Many forecasts were enamored with technology. The typical forecast included some kind of a detailed description of how the video player worked.

3. The forecasts generally did not consider media (or product) substitution effects. Many forecasts predicted success for both the VCR and the VDP. Instead, many early home video adopters chose to substitute the more versatile and expensive VCR for the VDP.

4. Absolute numbers were forecast rather than a range of possible outcomes. Those forecasts which projected sales or market penetration figures tended to either project a simple linear or logistic growth pattern.

5. The forecasters dramatically failed to address the social factors surrounding the adoption process. This may have been the single most glaring shortcoming of the available forecasts.

This analysis indicates that, as Godet (1983) and Twiss (1984) suggest, the development of forecast scenarios would be more useful for understanding the future of the home video technology. One scenario could have assumed that the manufacturers would have actively developed and promoted software before player introduction. Another scenario could have anticipated the reticence on the part of corporate players and other software developers to invest in software until some critical mass of players was in place. Although most forecast scenarios would be inaccurate, one or more might alert the forecast users to the course that actual events might be taking.

Finally, based on the analysis of the home video forecasts, the following suggestions are made for future forecasts of new communication technologies:

1. A number of possible scenarios should be developed for each technology. Potential barriers to the adoption and diffusion process must be identified and addressed.

2. Intermediate stages of development needed to reach the forecast outcome must be considered.

3. The assumptions and methods which drive the forecast must be clearly specified.

4. Historical analogy should be used to esablish a forecasting context rather than as the guiding assumption behind the forecast.

5. Both supply (producer) and demand (user) sides of the technology must be examined (consumer surveys may be useful). Thorough examination of the technical issues is necessary but not sufficient for the forecasting process. Social issues such as what existing media serve the same functions for the user must be addressed.

6. Alternative, complementary and substitute technologies must be examined. (Cable television may have had an enormous role to play in the rejection of the VDP while being a complementary technology for the VCR.)

7. Opposing points of view should be sought ought; forecasters should not rely on what is assumed to be "common knowledge." This may help diffuse the bandwagon effect in which forecasters tend to affirm rather than challenge each others' assumptions.

Perhaps the inherent obsolescence of any forecast once it is released has precluded forecasters from validating his/her key assumptions. A new task always awaits the professional forecaster. More work is needed criticizing past studies rather than simply creating more which may fall victim to the same mistakes. Although this research is a preliminary attempt to begin this process, more systematic study of past forecasts still needs to be done.

ENDNOTES

(1) For the complete report on this study, see Bruce Carl Klopfenstein, Forecasting the Market for Home Video Players: A Retrospective Analysis, unpublished doctoral dissertation, Columbus, Ohio: The Ohio State University, 1985. This work is available from University Microfilms as publication number 8510588.

(2) A review of these predictions is included in Bruce Klopfenstein, "A History of Home Video Player Forecasts and Predictions," paper presented at the Popular Culture Association convention, April 1986, in Atlanta, Georgia.

(3) The University of Maryland's Mark Levy has investigated VCR useage patterns and has published a number of articles on this subject. The most recent (see Levy and Finn, 1984) includes a summary of his earlier work.

(4) The VCR has another technical advantage over the VDP. While making a videodisc requires a complicated mastering process, dubbing videocassettes is very simple. Large numbers of videodiscs may be made less expensively than videocassettes, but the VC holds the advantage when smaller runs are needed.

APPENDIX

Forecast Studies in Reverse Chronological Order

John A. Dimling, Ronald W. McCabe and Wayne E. Schiedeknecht. Identification and Analysis of the Alternatives for Achieving Greater Television Program Diversity in the United States. Staff Paper 6 in Eugene Rostow, President's Task Force on Communications Policy, Washington, D.C., July 26, 1968.

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